

The necessity for perfection of extinction determinations for astronomy, and especially for solar investigation, will materially increase radiation measurement advances—and great advancement is indicated, thanks in no small degree to the cell method. If the astronomer is not able to determine with sufficient accuracy the amount of the permeability of the screen through which he must always look, and slight, transient changes in the same, then oscillations in the solar constant and in distribution of brightness over the sun's disk can hardly be determined with certainty. By masterly investigation Wilsing has fixed the limits within which the constancy of atmospheric condition must remain assured. An exact determination of the extinction coefficient has hardly less significance for meteorology and astrophysics.

#### SOLAR VARIABILITY AND TERRESTRIAL CONDITIONS.

Literature, especially American literature, lately abounds in investigations on the influence of the period of solar activity. Humphreys and Abbot called it forth by their investigations of climatic change in dependence on solar activity and volcanic eruptions; Huntington seeks to demonstrate a relation between varying distribution of spots over the sun and the air pressure distribution on the earth; according to Clayton the march of temperature in the tropics follows solar activity at an interval of three days; Nansen comes to the conclusion that the temperatures over the continents increase with the number of sun spots, while the temperatures over the oceans fall with such increase; Plaskett finds a relation between solar activity and the velocity of solar rotation; Bigelow even wishes to substitute for the monthly period the 26.68-day period of solar rotation.

There is no lack here and there of objections that the meteorological influences can mask, or be mistaken for

such relations, but nowhere does there appear to be clearly expressed what is understood from our preceding discussions—increase in solar activity involves increase in extraterrestrial radiation (apparently only in the short-waved, while the long-waved appears to diminish a little), but at the same time it decreases the transmissibility of the atmosphere, differently for different wave lengths, in contrast to terrestrial disturbances with their coarser particles, which diminish all kinds of radiation approximately equally. The two factors act in opposition, and it must be known how to resolve them in order to arrive at clear results. The observation of sky brightness, polarization, and diminution in brightness from the extraterrestrial light source to the neighboring sky point the way to this. These arguments can be considered only as sidelights over the field, the limits of which are not yet evident.

A brief suggestion fraught with deep significance may close these arguments. During the solar eclipse of May 29 of this year (1919), toward whose results the eyes of the scientific world are directed in expectation of a decision as to Einstein's theory, there appeared, according to news reports, an enormous gas cloud "close to" the sun's limb. Did this cloud lie in reality neither in nor near the sun, but in the earth's atmosphere? According to observations at Davos there began in the early morning of May 29 a considerable optical disturbance, and it faded away typically and very gradually till the middle of June; from other places there are similar reports. Was the refraction change connected with such possible disturbance able to impair the value of the observation, almost reaching the limit of accuracy, for a decision as to Einstein's gravitation theory? Was any attention given to the existence of an optical atmospheric disturbance at the critical points of observation, Sobral, in Brazil and Eddington in western Africa?

#### SMOKE FORMATIONS IN AIR DRAINAGE.

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#### INTRODUCTION.

In a report upon the temperature and the results of orchard heating in the vicinity of Roswell, N. Mex., on the morning of April 21, 1918, Mr. Hallenbeck wrote as follows:

There was one interesting feature of this freeze that is deserving of mention. For four or five hours the air was as nearly calm as I have ever observed for so long a period of time, and the smoke blanket was observed to drift very slowly for a short distance in one direction, then in another direction, frequently moving back over its path. Attempts to photograph heated orchards, after daylight, failed on account of the heavy smoke blanket. This condition (calm and clear) apparently was favorable to a maximum of cooling near the ground. Yet the damage to unheated orchards was mostly confined to the top halves of the trees. Mulberry trees around my residence had their tops badly frozen, while the lower foliage was unharmed. Young corn and beans, not more than 30 yards from these trees, were absolutely unharmed, although in the instrument shelter, about 200 feet away, the temperature was between 32° and 29° for four hours. Many orchardists who had not heated their orchards announced a day or two after the freeze that their crop was only slightly injured, only to discover a week later that the top halves of their trees were nearly bare of fruit.

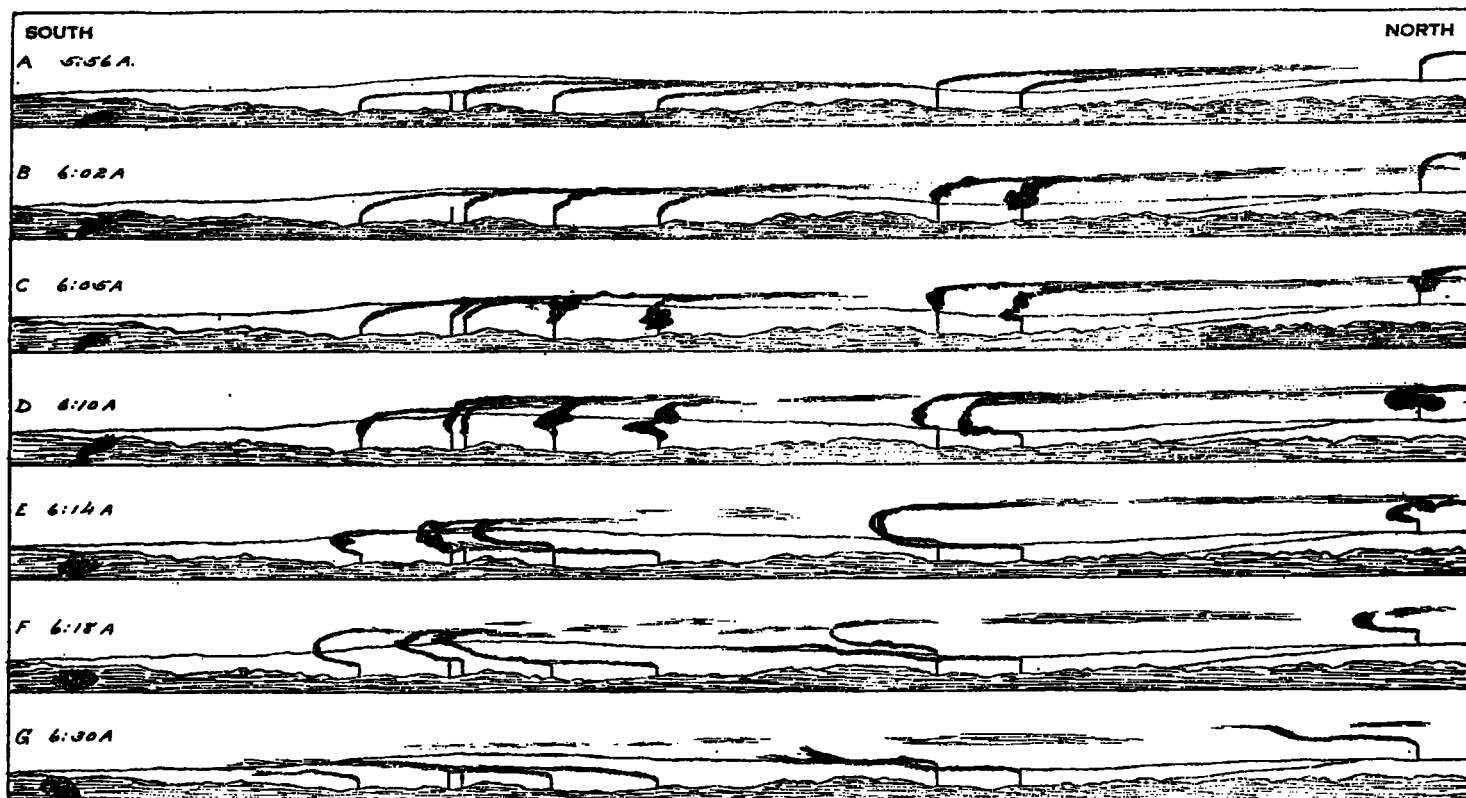
As the lowest temperature on clear, still nights is usually at the lower elevations, we suggested to Mr. Hallenbeck that he watch the condition in the future so as to ascertain under what general conditions the high-level damage is done. The probable explanation of this interesting phenomena is apparently given in the following paper. Mr. Floyd D. Young has recorded frequent and rapid fluctuations in temperature in the citrus groves at Pomona, Calif., due generally, however, to mixing of the warmer upper air with the cold-surface air. These fluctuations are most marked above the tops of the groves and

when there is a strong air draft at the 30-foot level. In one instance recorded, there was a change in temperature of 10° in four minutes at an elevation of 15 feet. At the 5-foot level at the same time there was very little interruption in the steady fall in temperature.—J. Warren Smith.

#### SMOKE FORMATIONS IN AIR DRAINAGE.

The figure here shown was constructed from sketches made on the morning of December 9, 1919. Each of the seven parts of the figure is a duplicate of the others, except for the smoke formations. In the foreground is a screen of orchards and shade trees; in the distance the visible horizon is indicated by a single line. At the extreme right the ground rises into what is known as "North Hill," on which the smokestack of the Military Institute is shown. At the extreme left is "vapor" rising from a flowing irrigation ditch. All the smokestacks are in a general north and south line, except the one at the left, which is about 0.3 mile farther west, while the irrigation ditch was within 100 yards of the observer. The smoke formations were observed and sketched from a point about 1 mile east of the city, the horizontal distance included being, at the line of smokestacks, about 1.6 miles. The general slope of the ground is ESE, but this slope is not visually perceptible east of the city.

It was, of course, impossible to go into detail in making a quick sketch of eight or nine different smoke clouds that were constantly changing, but the formations as shown are sufficiently accurate in general outline. Figure A was drawn from memory.



The drawing is probably sufficiently clear without explanation, but the writer begs to call attention to the fact that the smoke from the right-hand stack and the "vapor" from the irrigation ditch (the highest point and the lowest point, respectively), were the last to change their direction. The "vapor" from the ditch showed no perceptible direction until fully five minutes after the northerly current was fully established at the elevation of the smokestacks. This argues that the front of the advancing current was wedge-shaped, and was considerably in advance of its upper and lower portions. The detached shreds of smoke that, in D and E were apparently stationary, were drifting perceptibly to the south in F and G.

The Weather Bureau instruments are to the west of this line of smokestacks, and on higher ground, and are higher than any of the stacks except the one on the hill at the right. The writer has several times observed such smoke formations as these, in the early mornings, when the wind direction record of the Weather Bureau office showed a change of only 45° or sometimes no change at all, indicating that the drainage current is sometimes so limited in depth as to be entirely below the moderate elevation of the Weather Bureau instruments.

Several cases have been observed of air drainage, occurring after sunrise, that was stopped in the vicinity of Roswell. The reader can, by starting with A, going as far down the series as he chooses, and then reversing the process, form a very good idea of the smoke formations in such cases.

Since the air of the drainage current is colder than the air it replaces (from 2 to as much as 15° F., as shown by thermograph traces) it seems very probable that the "high freezes" which sometimes occur in the Pecos Valley are due to arrested air drainage, or at least to drainage currents that are not sufficiently developed or which do not progress far enough to disturb materially the lowest stratum of air. Friction with the surface of the ground would tend to retard the progress of the lower portion of the drainage current, and when to this is added the retarding influence of the masses of orchards, shade trees,

etc., that cover the cultivated belt of the valley, it seems reasonable to believe that the reversal of wind direction at a moderate distance above ground might occur some time before it is felt near the surface. Cases have been observed where the foliage and blossoms in the upper portions of orchards were almost entirely destroyed by freezing when the lower portion, as well as tender vegetation close to the ground, was untouched. In one such freeze, in the spring of 1918, the demarkation was almost abrupt. The writer is informed that such freezes occur less frequently farther down the valley than in the vicinity of Roswell, and the one just referred to did not extend farther than 18 miles south of Roswell.

A series of thermograph records were made during the fall of 1918 and the spring of 1919, at elevations of 5 feet and 24 feet, to ascertain, if possible, the cause of high freezes. When air drainage occurred, it *always* was colder at the upper level than at the lower; the difference usually was not great, but on occasions was as much as 7° and 8°. A few cases were noted where there was a sharp morning fall in temperature at the upper elevation, amounting to 3° to 5°, with no perceptible acceleration of the normal radiational cooling at the lower level. This can be explained only by assuming an overrunning current of colder air. It might be added that a minimum thermometer, installed 2 inches above ground in an improvised shelter, showed readings uniformly 1° to 2° higher than in the shelter 5 feet above ground.

The writer is convinced that the drainage current is nothing more than the down-valley flow of air that has been greatly cooled by nocturnal radiation, and that it originates over the region lying north of the cultivated district. This region is bare prairie, normally quite dry in spring, over which the night radiational cooling would be much greater than in the lower valley where the ground is cultivated, irrigated, and covered with growing crops. This difference between the soil and the soil covering is sufficient to account for the difference in temperature noted after six to ten hours radiational cooling.